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Original Research Article

ENDOTRACHEAL TUBE CUFF PRESSURE MEASUREMENT DURING GENERALANAESTHESIA - INSTRUMENTAL VERSUS CONVENTIONAL METHOD

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Abstract: Endotracheal tubes (ETT) that we use now-a-days have high volume, low pressure cuff but hyperinflation of the cuff can cause inflammation of the endotracheal layer; ischemia or necrosis of the tracheal wall while under expansion increases the risk of lung aspiration, anaesthetic gas leaks, and environmental pollution. It is important to maintain proper cuff pressure when inflating the endotracheal tube (ETT) cuff, as serious adverse events can occur at both too high and too low cuff pressures. These an attempt had been made to evaluate the efficacy of ETT cuff pressure measurement using conventional clinical method of digital palpation of pilot balloon by comparing with instrumental method using standard cuff pressure manometer or AG cuffill instrument. A 20-30 cm water column cuff pressure is recommended to prevent aspiration and ventilator-related pneumonia. The study was conducted to evaluate the conventional practice of endotracheal tube (ETT) cuff inflation and pressure measurement as compared to the instrumental method using AG cuffill syringe.

Methodology: The study was a comparative study, conducted in the department of anaesthesia, Gandhi medical college and hospital, Bhopal. The study population included patients planned for surgeries under general anaesthesia intubated with cuffed endotracheal tube. Patients with known laryngotracheal abnormalities were excluded from the study. Total of 100 patients were included for the study. The cuff of endotracheal tube was inflated with 10 ml syringe. After satisfactory inflation it was checked clinically by digital palpation of pilot balloon. Later within 5 minutes of induction cuff pressure was checked using standard AG cuffill Syringe. ETT cuff pressure of 20-30 cms of water was set as standard and pressures outside this were adjusted to this range.

Result: Only **11** patients' cuff pressure was found in recommended range**.** The Mean cuff pressure was found to be **56.63** ±**19.56** cm of water**.** the Highest recorded pressure was **90** while lowest recorded pressure was **22** cm of water.

Conclusion: Conventionally, the clinical method of inflating pilot balloon and digital palpation to achieve the ideal cuff pressure is unreliable and hence the instrumental method should be used to avoid the post operative complications.

Key words: endotracheal tube, cuff pressure, AG cuffill syringe

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1. INTRODUCTION

A very important function of the endotracheal tube cuff is to seal the airway, but it should neither be over inflated nor under inflated. Under inflation of the cuff leads to gaseous leaks and macro and micro aspiration of pharyngeal contents into the trachea during ventilation while excessive cuff pressure decreases tracheal capillary perfusion and leads to sore throat post operatively. Also, Once the cuff contacts the tracheal wall, the pressure rises rapidly. Thus, ETT cuff pressure must be in a range that ensures delivery of the prescribed mechanical ventilation tidal volume, reduces the risk for aspiration of secretions that accumulate above the cuff without compromising the tracheal perfusion. A cuff pressure of 20–30 cm of water is recommended for the prevention of above mentioned complications.
Post intubation sore throat is a common side effect of general anaesthesia. This may result from ischemia of the oropharyngeal and tracheal mucosa due to over-inflation of the cuff. We have conducted an observational study to evaluate the efficacy of cuff inflation and assessment of conventional method and instrumental measurement of cuff pressure. In our study we have used AG cuffill syringe to measure ETT cuff pressure, which is a pocket syringe. It is attached to pilot balloon to measure cuff pressure in cm of water.

AIMS AND OBJECTIVES:
Primary: The main goal of this study is to evaluate the conventional practice of ETT cuff inflation and pressure measurement as compared to the instrumental method and to study the best method to avoid overinflation and underinflation.
Secondary: To identify and prevent consequences occurring due to overinflation and underinflation of ETT cuff by adjusting the pressure to the ideal range.
Type of study: Prospective observational hospital based study
Location: Operating room of Gandhi Medical College, Bhopal
Sample size: 100 patients undergoing surgeries under general anaesthesia

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Inclusion criteria	Exclusion criteria
ASA Grade I, II and III	Known anatomical laryngotracheal abnormalities
Age between 18 – 65 years	Patients with high risk of aspiration
Patients Under General anaesthesia for elective surgeries.	Patients with anticipated difficult intubation or having a history of difficult intubation

2. METHODOLOGY:

A prospective observational study was performed after taking Informed consent from the patients who met the inclusion and exclusion criteria. Hundred adult patients above 18 years of age scheduled for elective surgical procedure requiring general anaesthesia and endotracheal intubation were included in the study. Patients were pre medicated in the pre operative area. Inside the operation theatre General anaesthesia was induced using intravenous bolus of inducing agent Inj. Propofol 2mg /Kg and paralysis was achieved using a depolarizing muscle relaxant Inj. Succinylcholine 2mg/kg. Patients' trachea were intubated with a 7.0 mm/7.5 mm internal diameter PVC ETT. Anaesthesia was maintained with sevoflurane/isoflurane , a volatile anaesthetic agent, in a combination of nitrous oxide, oxygen and Inj atracurium. The duration of the study was 6 months. A 10 ml syringe was used as a routine for ETT cuff inflation.

Adequacy of cuff inflation is generally assessed by palpation of the pilot balloon and sometimes readjusted by anaesthetist by inflating just enough to stop an audible leak around the cuff. The cuff pressure was measured by AG cuffill syringe. The AG cuffill syringe was connected to the pilot balloon of the ETT and ETT cuff pressure was measured and recorded.

3. RESULT:

Endotracheal tube cuff pressure was measured in 100 adult patients who underwent elective surgical procedures under general anaesthesia requiring endotracheal intubation. There was no significant difference in age, weight, and duration of surgery. The overall incidence of ETT cuff pressures within the recommended range (20–30 cm of water) was 11% and in 89% it was above the recommended range. None of the measured cuff pressures was below the recommended range. The mean cuff pressure was 56.63 cm of water, which is above the standard. The lowest pressure measured was 22 cm of water and highest cuff pressure was 90 cm of water. In 10% the pressure range was 30-40 cm of water, in 22% the pressure range was 40-50 cm of water, in 13% the pressure range was 50-60 cm of water, in 15% the pressure range was 60-70 cm of water, in 9% the pressure range was 70-80 cm of water and in 20% the pressure range was 80-90 cm of water. In 11% patients only the pressure was measured between 20-30 cm of water.

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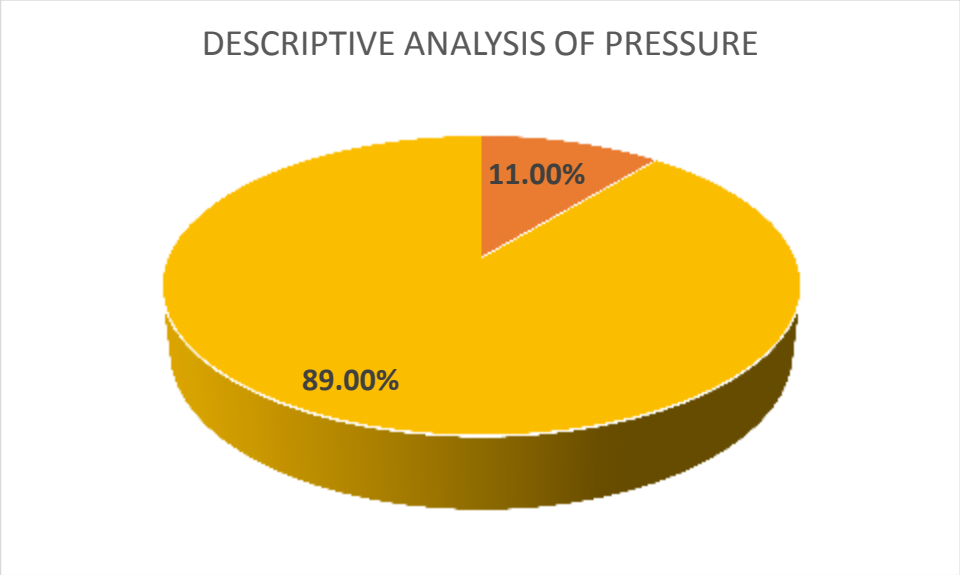
Cuff Pressure in cm of water	Number of Patients	Percentage
< 20	0	0%
20-30	11	11.00%
30-40	10	10.00%
40-50	22	22%
50-60	13	13.00%
60-70	15	15.00%
70-80	9	9.00%
80-90	20	20.00%
TOTAL	**100**	**100%**



	PRESSURE (in cm of water)
MEAN	**56.63**
MAX	**90**
MIN	**22**
STANDARD DEVIATION	**19.56**

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4. DISCUSSION:

The pressure exerted on the tracheal wall is one of the primary determinants of tracheal injury.[8] The intra-cuff pressure in intubated patients should be high enough to prevent macroscopic aspiration and an air leak to ensure adequate ventilation. The cuff pressure should be adequate enough not to impair the mucosal blood flow.[9] It has been shown that continuous lateral wall cuff pressure above 30 cm water compromises blood flow, and cuff pressure above 50 cm water completely obstruct the tracheal wall blood flow.[10] It is reported that high ETT cuff pressure lasting more than 15 min resulted in obstructed mucosal blood flow, the columnar epithelium was destroyed, and basement membrane is exposed.[8,9,10] Damage to the trachea during intubation is inevitable as a result of the contact between the ETT and the trachea.[8] Digital balloon palpation corresponds poorly with the measured endotracheal cuff pressure, and anaesthetist experience corresponds poorly with measured cuff pressures.[8,10,11,12] The instrumental measurement and adjustment of cuff pressure resulted in a significantly lower incidence of post procedural sore throat, hoarseness, and blood-stained expectorant.[13] When conventionally adjusted cuff pressure was measured in different settings, the reported cuff pressures in most of the cases ranges between 40 and 50 cm H2O.[13,14,15] The highest recorded ETT cuff pressure in our study was 56.63 cm H2O, and most of the patients (89%) were having high cuff pressure. In our study, we observed that the use of bigger size syringe (10 ml) is one of the important factors for over inflating the ETT cuff, resulted in high cuff pressure. It was shown that there is linear relationship between the measured cuff pressure and the volume of air retrieved from the cuff. We found that volumes between 3 to 5 ml usually produce cuff pressures between 20 and 30 cm H2O, independent of tube size for the same type of tube. Thus it is better to use a 5 ml syringe alternative to the traditional bigger size syringe. *Khan Mueenullah et al.* A total of 100 adult patients were observed according to the syringe size used. Group-1 (10 ml) and Group-2 (20 ml) for ETT cuff inflation in general anesthesia. They concluded that the cuff inflation with 20 ml syringe resulted in higher cuff pressure as compared to 10ml syringe 37.73 ± 4.23 versus 40.74 ± 5.01.

Kayalvizhi Periyasamy et al. also found that Majority (46%) of the participants belonged to 40 - 59 years of age. Majority of the participants (52%) were males. It was observed that only in 10% of the participants a normal inflation was achieved. Overinflation occurred in 90% of the participants. [15]

This study has highlighted the issue of training and awareness among anaesthesia personnel regarding cuff inflation and cuff pressure measurement technique. Minor but common complications like postoperative sore throat can be prevented using a routine simple aneroid instrument for cuff inflation and pressure measurement rather than relying on conventional methods.

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5. CONCLUSION:

The conventional method for ETT cuff inflation and digital palpation method of balloon pressure measuring is unreliable. Instrumental cuff pressure monitoring is simple and inexpensive[17,18] and suggested to be used as a routine.

Conflicts of interest: No conflict declared by the authors

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